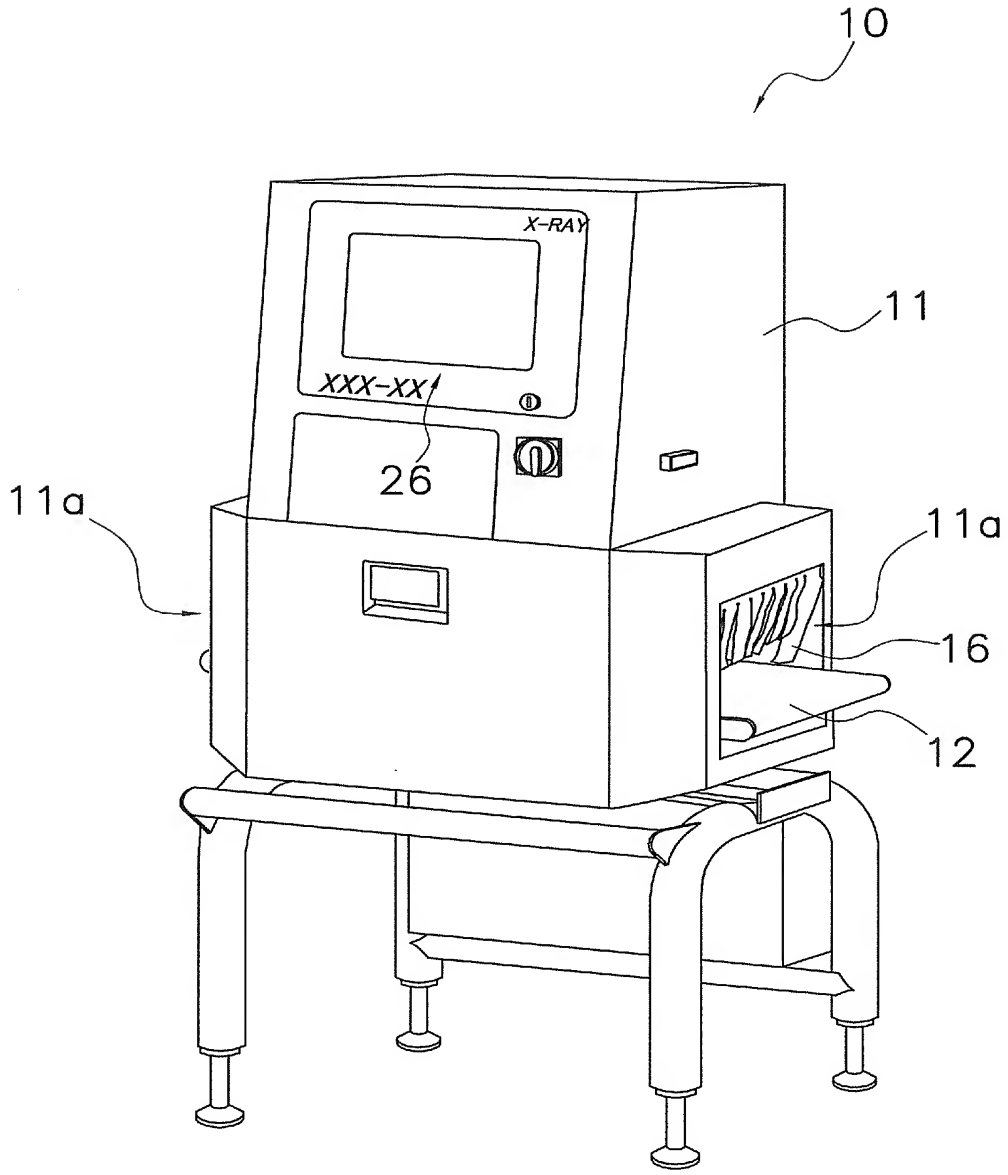


Fig. 1

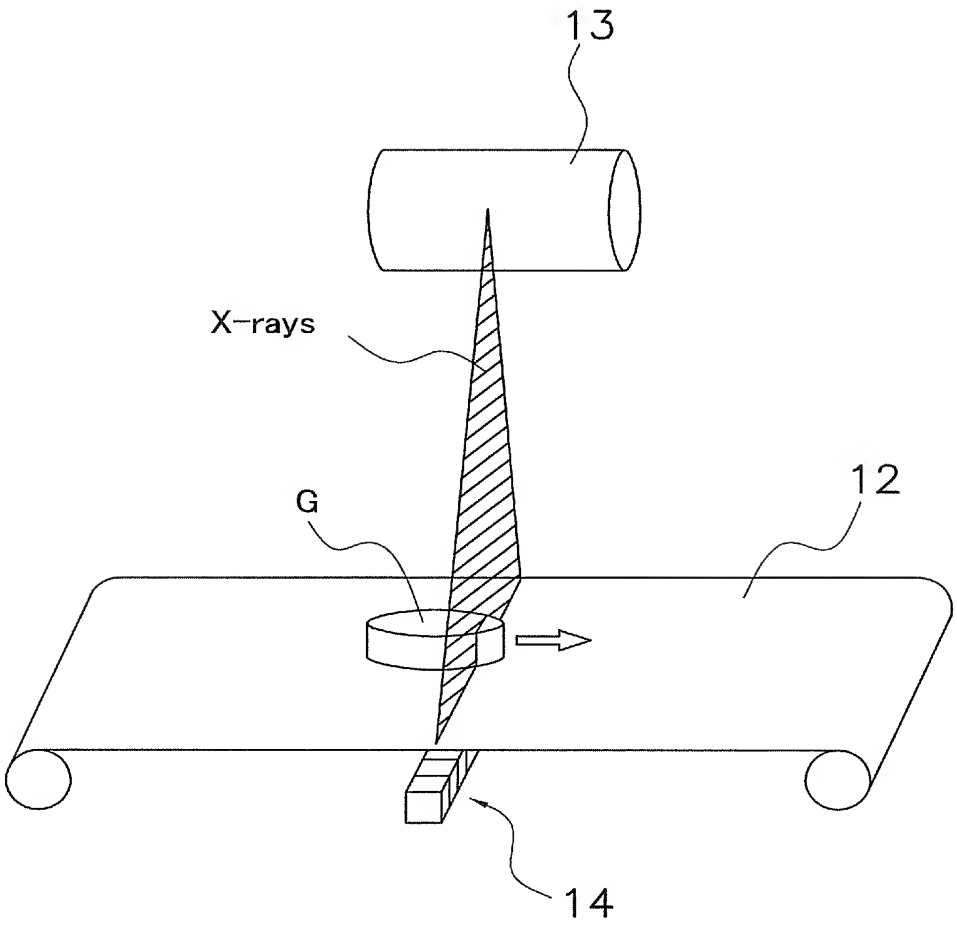


Fig. 2

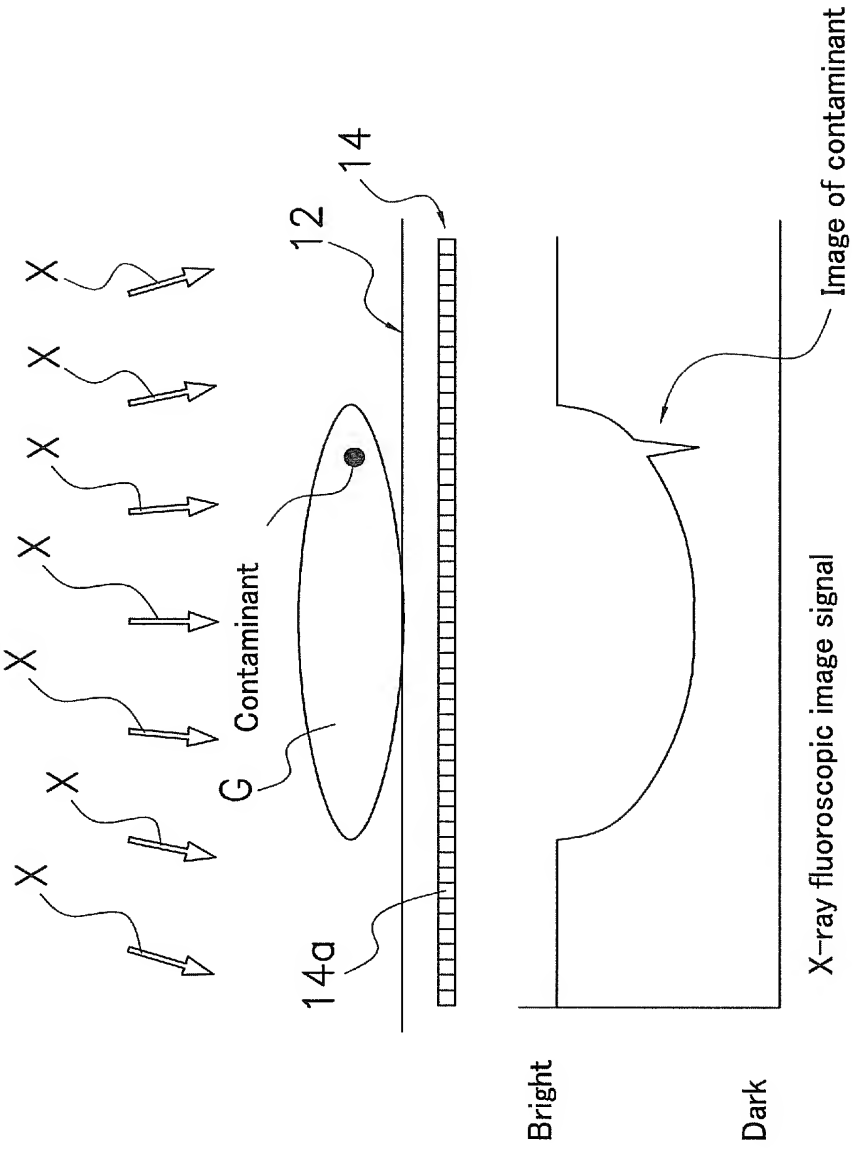

X
X
X
X
X
X
X
X
G
Contaminant
12
14
14a
Bright
Dark
X-ray fluoroscopic image signal
Image of contaminant

Fig. 3

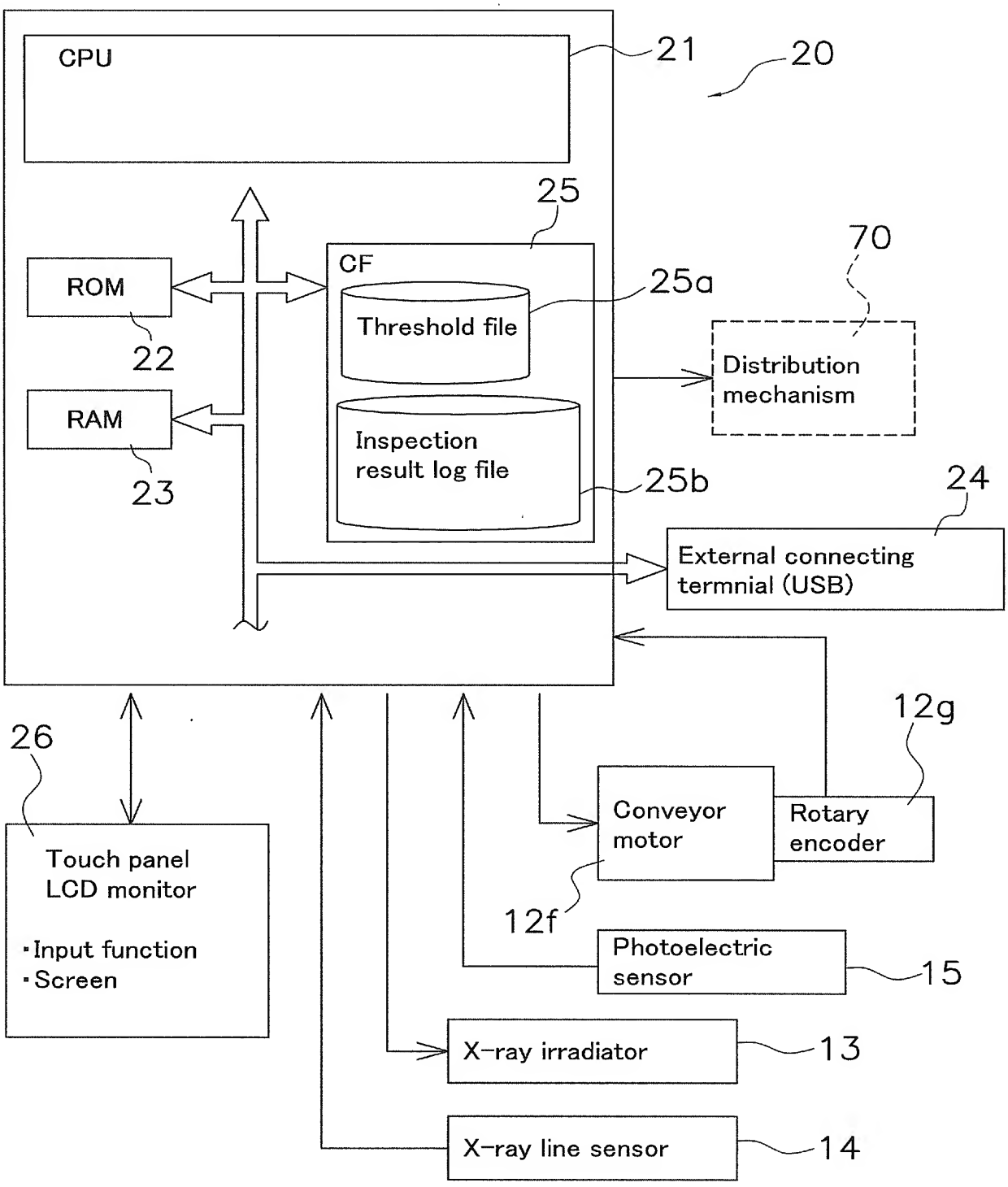

CPU
21
20
25
CF
70
ROM
25a
Threshold file
22
Distribution mechanism
RAM
Inspection result log file
23
25b
24
External connecting termnial (USB)
12g
26
Conveyor motor
Rotary encoder
Touch panel LCD monitor
12f
Photoelectric sensor
15
·Input function
·Screen
X-ray irradiator
13
X-ray line sensor
14

Fig. 4

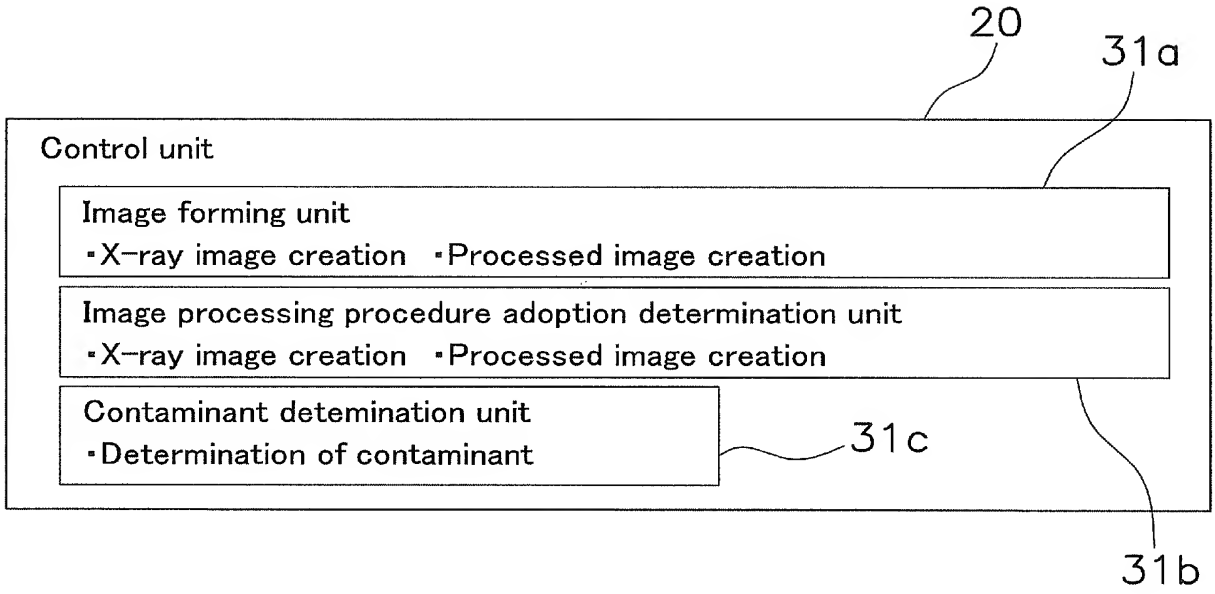

20
31a
Control unit
Image forming unit
・X-ray image creation ・Processed image creation
Image processing procedure adoption determination unit
・X-ray image creation ・Processed image creation
Contaminant detemination unit
・Determination of contaminant
31c
31b

Fig. 5

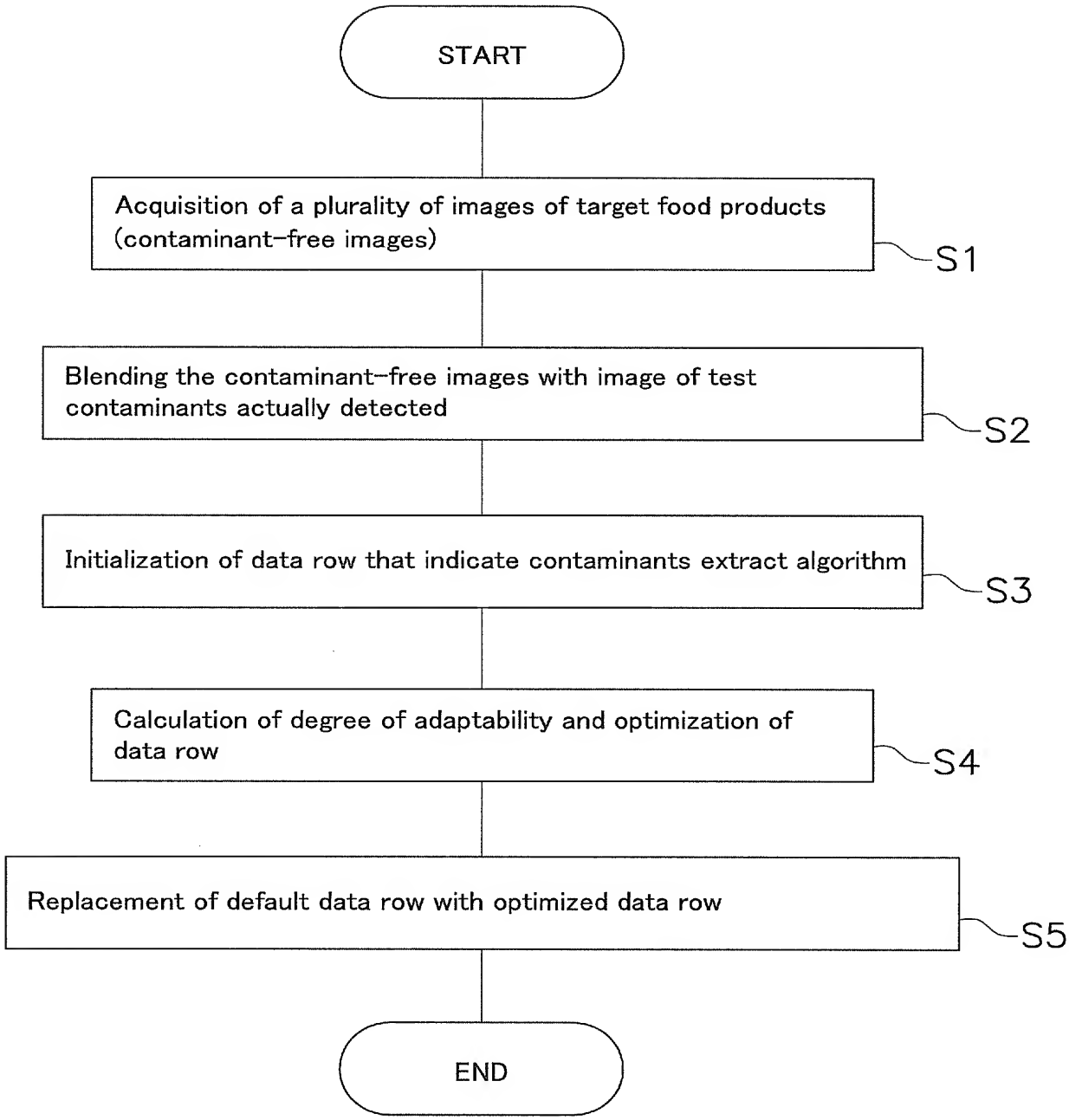

START
Acquisition of a plurality of images of target food products (contaminant-free images)
S1
Blending the contaminant-free images with image of test contaminants actually detected
S2
Initialization of data row that indicate contaminants extract algorithm
S3
Calculation of degree of adaptability and optimization of data row
S4
Replacement of default data row with optimized data row
S5
END

Fig. 6

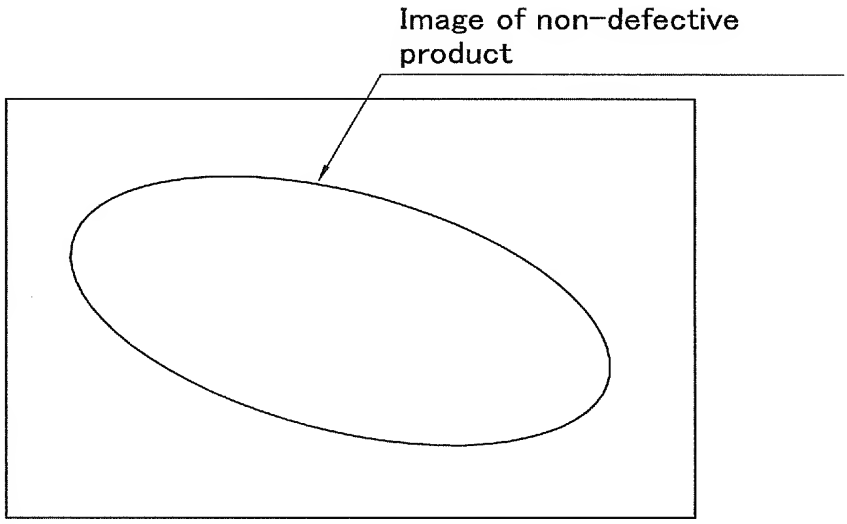


Image of non-defective product

(a)

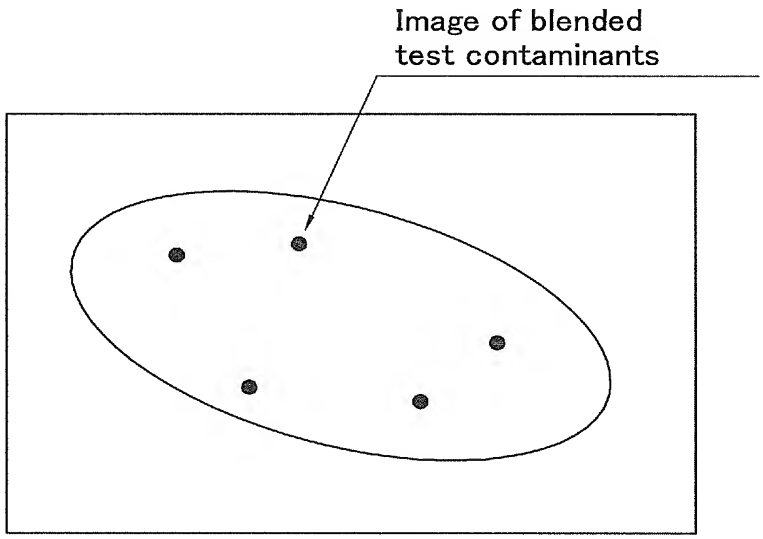


Image of blended test contaminants

(b)

Fig. 7

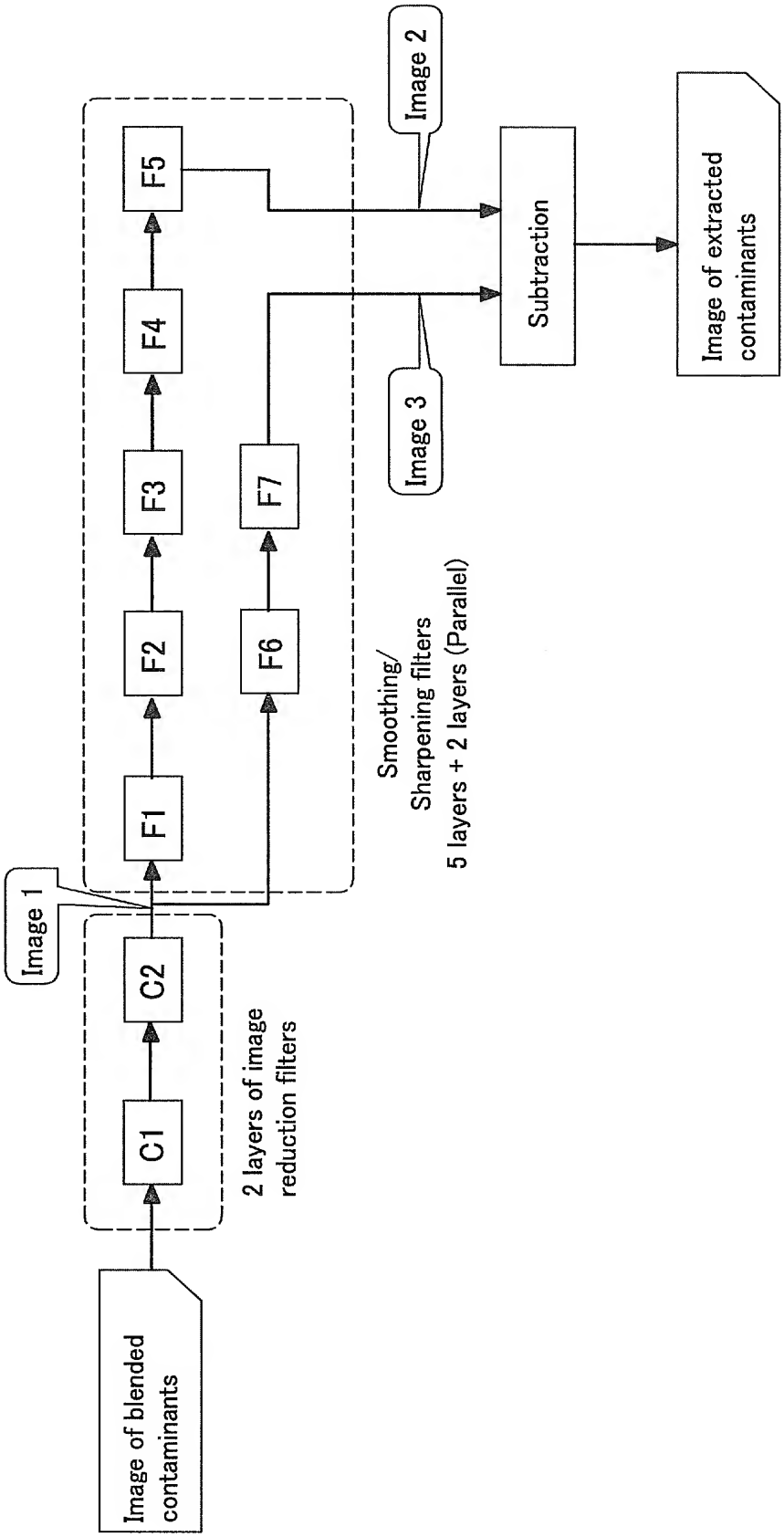
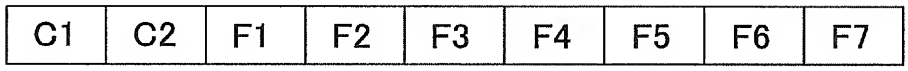
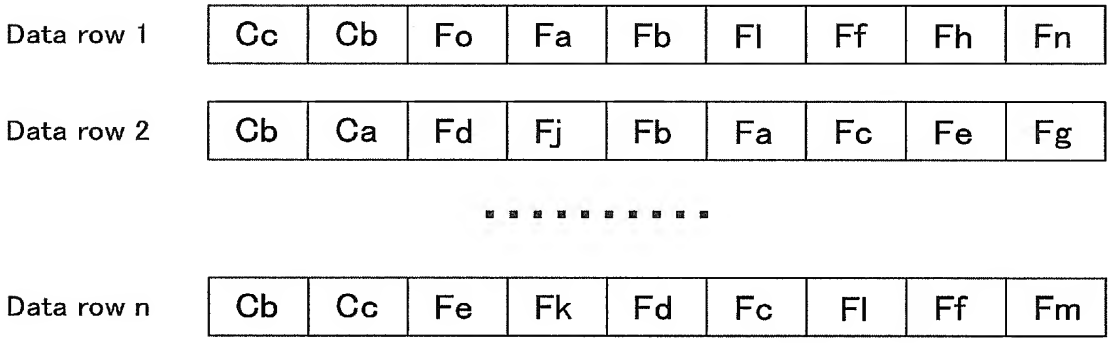


Image of blended contaminants
C1
C2
2 layers of image reduction filters
Image 1
F1
F2
F3
F4
F5
F6
F7
Smoothing/
Sharpening filters
5 layers + 2 layers (Parallel)
Image 2
Image 3
Subtraction
Image of extracted contaminants

Fig. 8


C1
C2
F1
F2
F3
F4
F5
F6
F7

(a)


Data row 1
Cc
Cb
Fo
Fa
Fb
Fl
Ff
Fh
Fn
Data row 2
Cb
Ca
Fd
Fj
Fb
Fa
Fc
Fe
Fg
Data row n
Cb
Cc
Fe
Fk
Fd
Fc
Fl
Ff
Fm

(b)

Fig. 9

Ranking	Processing time	Filter	Increase/Decrease rate (%)
1	N/A	Fa (No process)	+10%
2	Short	Fb, Fg, Fi	±0%
3	Medium	Fc, Fe, Ff, Fh, Fj, Fm, Fn, Fo	−10%
4	Long	Fd, Fk, Fl	−20%

Fig. 10

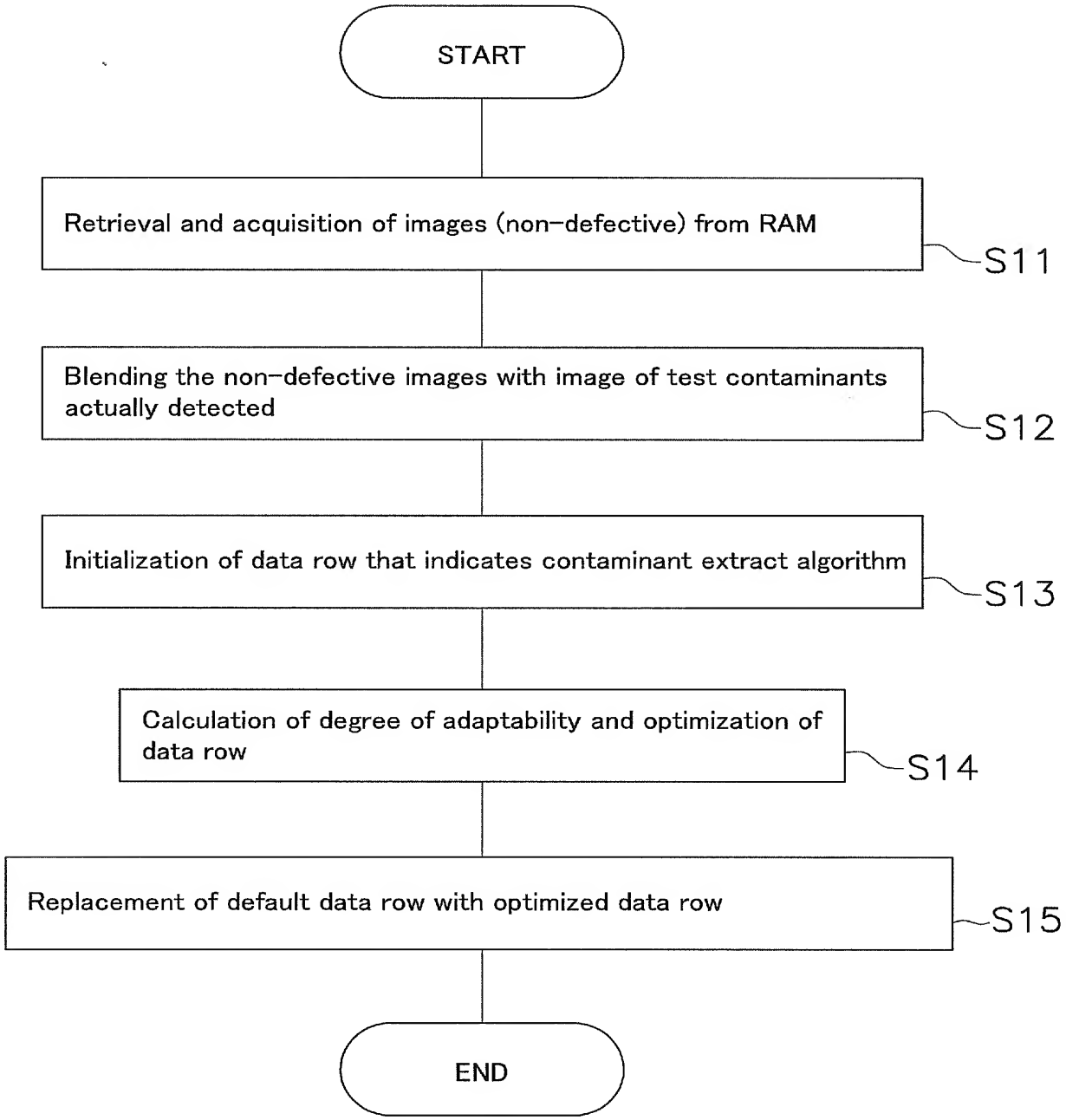

START
Retrieval and acquisition of images (non-defective) from RAM
S11
Blending the non-defective images with image of test contaminants actually detected
S12
Initialization of data row that indicates contaminant extract algorithm
S13
Calculation of degree of adaptability and optimization of data row
S14
Replacement of default data row with optimized data row
S15
END

Fig. 11

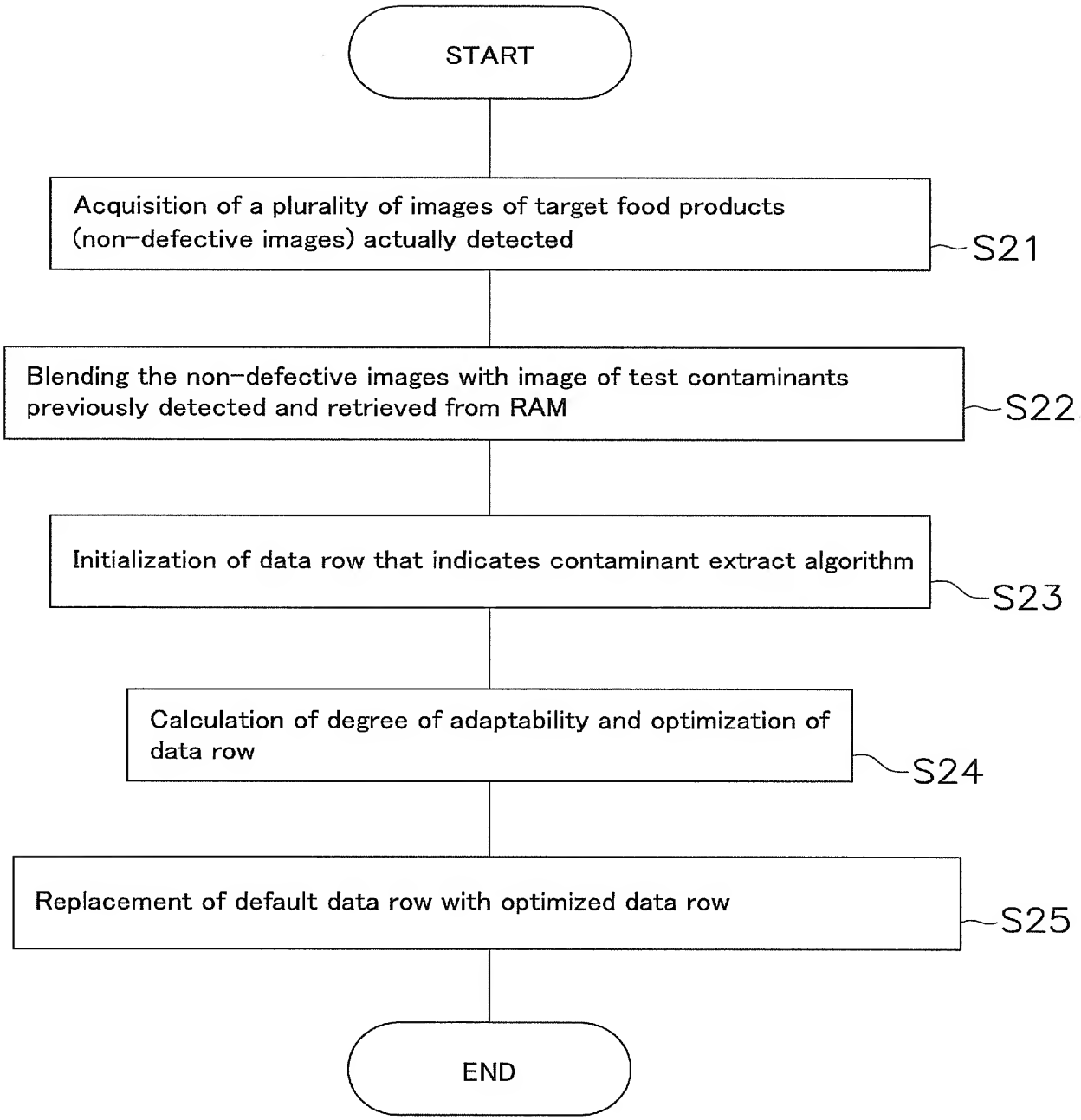

START
Acquisition of a plurality of images of target food products (non-defective images) actually detected
S21
Blending the non-defective images with image of test contaminants previously detected and retrieved from RAM
S22
Initialization of data row that indicates contaminant extract algorithm
S23
Calculation of degree of adaptability and optimization of data row
S24
Replacement of default data row with optimized data row
S25
END

Fig. 12

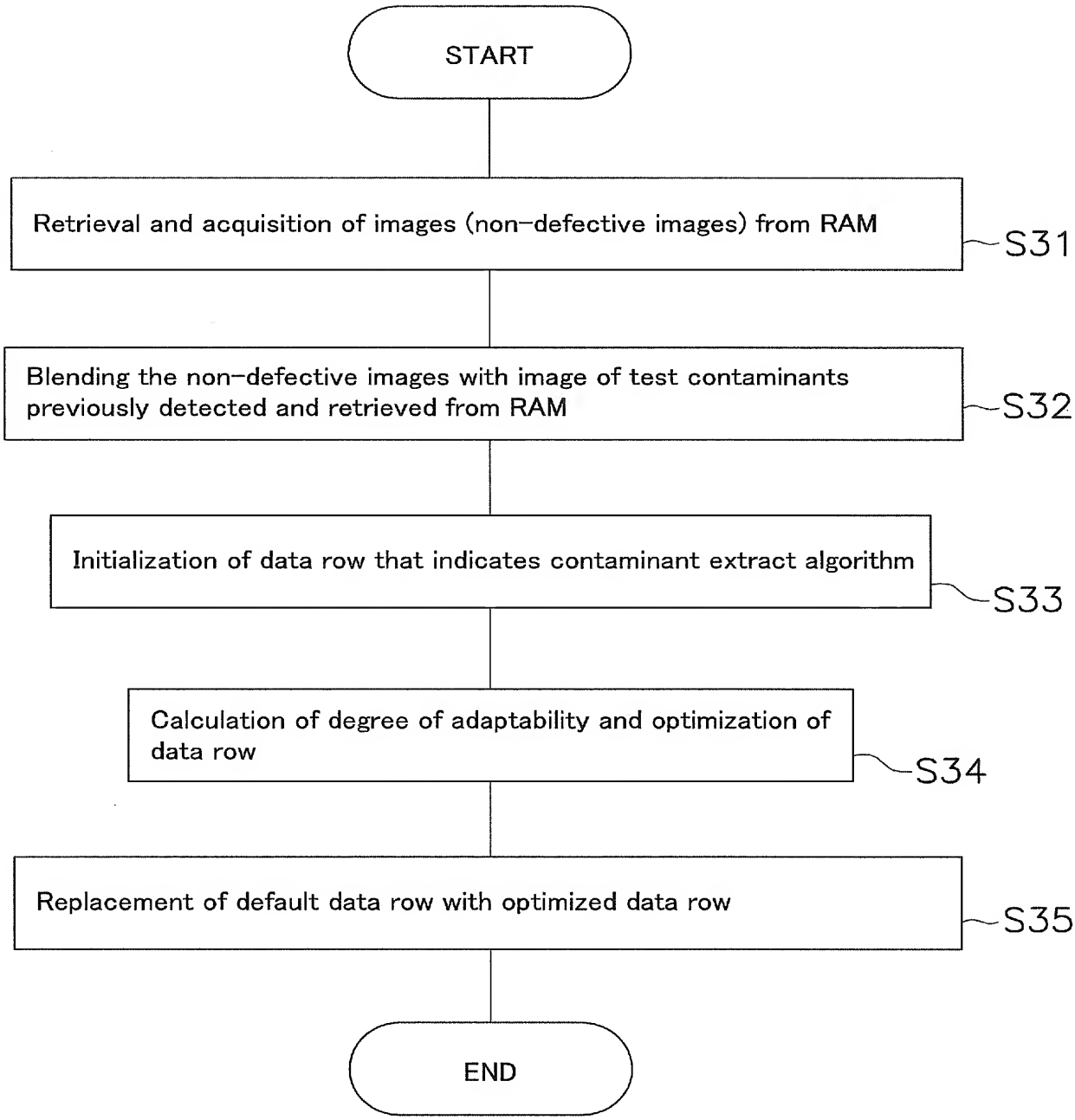

START
Retrieval and acquisition of images (non-defective images) from RAM
S31
Blending the non-defective images with image of test contaminants previously detected and retrieved from RAM
S32
Initialization of data row that indicates contaminant extract algorithm
S33
Calculation of degree of adaptability and optimization of data row
S34
Replacement of default data row with optimized data row
S35
END

Fig. 13

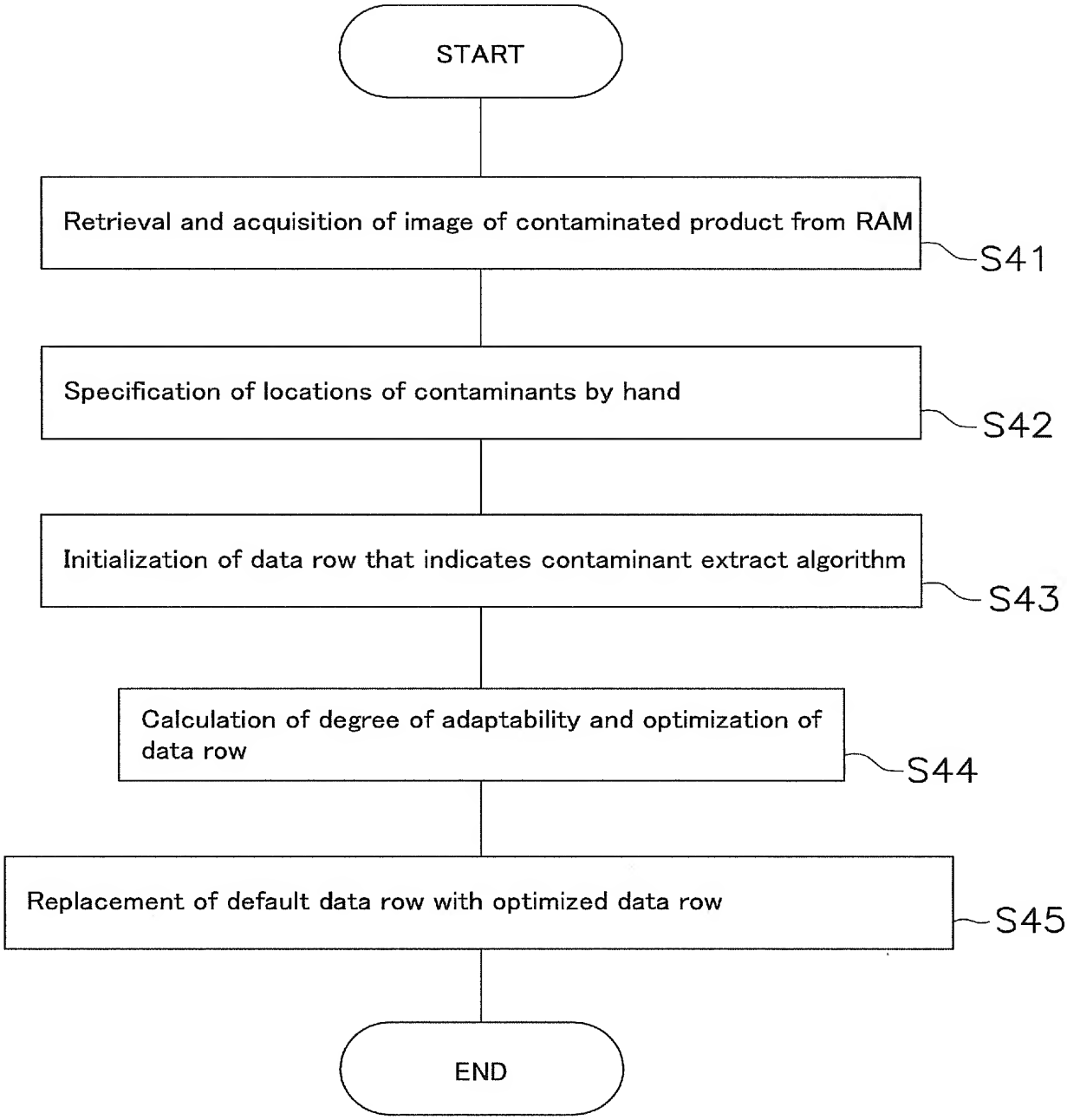

START
Retrieval and acquisition of image of contaminated product from RAM
S41
Specification of locations of contaminants by hand
S42
Initialization of data row that indicates contaminant extract algorithm
S43
Calculation of degree of adaptability and optimization of data row
S44
Replacement of default data row with optimized data row
S45
END

Fig. 14

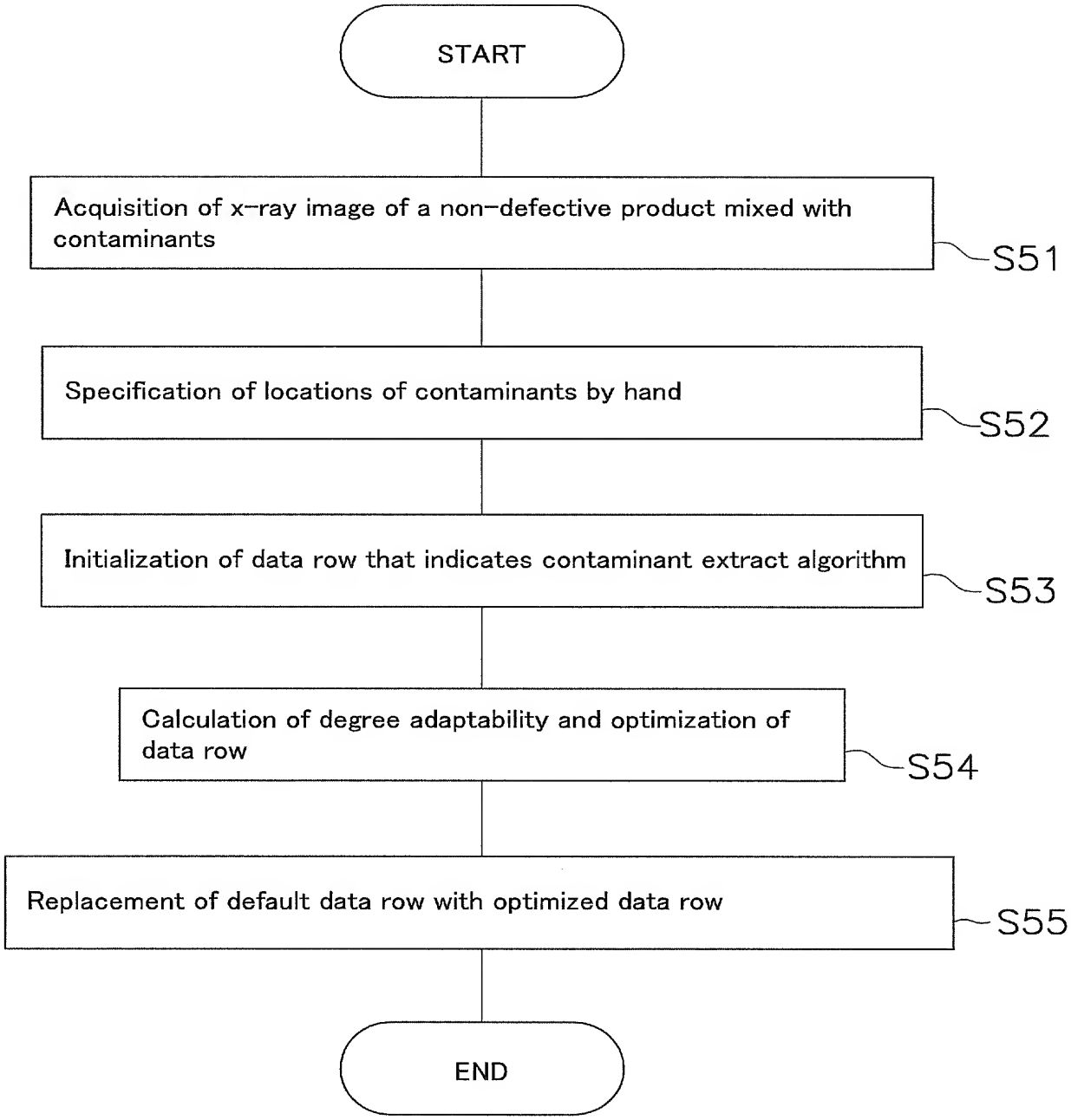

START
Acquisition of x-ray image of a non-defective product mixed with contaminants
S51
Specification of locations of contaminants by hand
S52
Initialization of data row that indicates contaminant extract algorithm
S53
Calculation of degree adaptability and optimization of data row
S54
Replacement of default data row with optimized data row
S55
END

Fig. 15